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Chapter Thirty-seven

TEMPORARY EROSION AND SEDIMENT CONTROL

37-1.0 GENERAL INFORMATION

Erosion and sediment control plans are required to be submitted to the applicable local Soil and Water Conservation District (SWCD) to comply with 327 IAC 15-5 (Rule 5) where 2 ha or more are disturbed. INDOT *Standard Specifications* and *Standard Drawings* have been developed for erosion and sediment control to formalize and expand on existing measures available to the designer. These guidelines will aid the designer in choosing the appropriate measures and frequency of their use. Although Rule 5 requires erosion and sediment control measures for 2 ha or more, these measures should be applied to all projects wherever land is disturbed. Formal submittal to comply with Rule 5 is not required where less than 2 ha are disturbed. However, where soil is disturbed, an erosion and sediment control plan must be developed. This is particularly important where sediment might be able to enter waterways.

The goal of the erosion and sediment control plan is to minimize the amount of sediment generated by construction operations leaving the construction site. Water flowing through construction-disturbed areas is to be filtered of sediment before it mixes with water which is not affected by construction operations. These guidelines concentrate on temporary erosion and sediment control measures. It is the designer's responsibility to include permanent measures where warranted. The designer should keep in mind that temporary erosion control measures should be in compliance with the construction clear zone criteria shown in Chapter Eighty-two. The erosion and sediment control plan should address erosion and sediment control during the entire construction process. This may mean that different measures will be used during different phases of construction. Likewise, allowance should be made for changes in the field to fit existing conditions or the use of different measures where they are more appropriate. These erosion and sediment control measures have been listed in groups according to their use. Some of these measures may be used in multiple applications.

A copy of Rule 5 is available via the Indiana Department of Environmental Management (IDEM) web site, at www.ai.org/legislative/iac/title327.html. It lists items that should be submitted with the erosion and sediment control plan to the applicable SWCD. A checklist of items that should be considered when complying with Rule 5 is found in Figure 37-1A. The erosion and sediment control plan should be prepared and submitted to the appropriate SWCD. In addition, the Notice of Intent letter should be filed with IDEM. The submittals should be as follows:

1. Plans developed for central office projects will be filed by the Design Division's Permit Coordinator.

2. Plans developed by the district will be filed by district personnel.

3. Plans developed for local public agency projects will be filed by the local agency

37-2.0 SITE ANALYSIS

The erosion and sediment control plan should identify control measures that will be used to minimize erosion and off-site sedimentation. It serves as a blueprint for the location, installation, and maintenance of these measures.

When preparing the erosion and sediment control plan, the designer should start by looking at local drainage patterns and topography. Volumes of water entering and leaving the construction site at various locations should be taken into consideration. Where reasonable, off-site waters should be isolated and allowed to pass through the project site. Sediments from on-site sources should be captured prior to leaving the site. The method of treatment depends upon the drainage area.

Providing a vegetated ground cover is the most important factor in terms of preventing erosion. If the existing vegetation is to be disturbed, appropriate erosion and sediment control measures should be utilized. If utility features traverse the site, their relocation should be taken into consideration when designing these measures.

The following principles of erosion and sediment control should be utilized.

1. The physical characteristics of the site should be assessed, including topography, soils, and drainage to determine how to best minimize erosion and sedimentation.

2. The erosion and sediment control plan should be designed to include measures that will keep sediment on the construction site as much as possible.

3. Where reasonable, perimeter dikes and waterways should be used to divert/intercept off-site runoff.

4. Measures to slow runoff and allow deposition of sediment should be designed using grading and sediment barriers to break up long, steep slopes.

5. Temporary seeding should be utilized wherever applicable.

6. Runoff velocity should be reduced by maintaining existing vegetative cover, preserving a natural buffer strip around the lower perimeter of the disturbed land, and installing perimeter controls such as sediment barriers, silt fences, filters, dikes, and sediment basins or traps.

7. The contractor should be provided adequate working space to construct/repair/maintain erosion control features.

The construction clear zone should be determined in order to select the appropriate erosion control measures. Chapter Eighty-two contains the information necessary to determine the construction clear zone. Straw bales should be used instead of riprap for ditch checks in the construction clear zone.

37-3.0 TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

37-3.01 Protection of Adjacent Areas

These measures are used to minimize sediment to areas adjacent to the disturbed areas. These measures include silt fence, vegetative filter strips, sediment traps and sediment basins.

37-3.01(01) Silt Fence

A silt fence is a fabric barrier used to retain sediment from small, sloping disturbed areas by reducing the velocity of sheet flow. See the INDOT *Standard Drawings* for details. Silt fence requires a trench for proper installation and should not be used on fill slopes. Silt fence captures sediment by ponding water to allow deposition, not by filtration. Although the practice usually works best in conjunction with other erosion control measures, it can be effective when used alone under the proper field conditions. A silt fence is not recommended to divert water; nor is it to be used across a stream, channel, or anywhere that concentrated flow is anticipated.

Use of silt fence is limited to disturbed sites in a drainage area. The use of silt fence is further restricted by the slope (grade), as indicated in Figure 37-3A. The silt fence should be installed nearly level, approximately following the land contour. Ideally, silt fence should be installed at least 3 m from the toe of slope to provide a broad, shallow sediment pool with increased storage capacity.

The length of silt fence should be sufficient to encompass the boundaries of the toe of the slope with the ends of the fence terminated upslope. In addition, the silt fence should terminate at adjacent erosion control measures or at stabilized areas.

For areas and slopes greater than those provided in Figure 37-3A, additional erosion control measures should be utilized such as slope drains, sediment traps/basins, temporary/permanent stabilizations, etc.

Where site conditions exceed the limits shown in Figure 37-3A, other appropriate erosion and sediment control measures should be implemented in conjunction with the silt fence.

37-3.01(02) Vegetative Filter Strip

Leaving existing grassy vegetation in place is the most effective method for erosion control. Often it is not practical or possible to leave all existing vegetation in place. In these situations it is still best to maintain as much existing vegetation as possible, which will accomplish two objectives. The vegetation will reduce erosion, and it will act as a filter trap for sediment from upslope areas. A vegetative filter strip is an area where the ground cover is to be left undisturbed to filter runoff from a drainage area. Filter strips are generally located between a sediment-producing site and a downslope site or watercourse. The locations which are not to be disturbed by the contractor should be shown in the erosion and sediment control plan.

Typical applications for this sediment control measure include areas adjacent to right-of-way limits, roadside ditches, relocated/existing waterways, or wetlands.

The vegetative filter strip's effectiveness is increased when it is used in conjunction with other measures such as silt fences, inlet protection, and sediment traps and basins, etc.

The effectiveness of vegetative filter strips is dependent upon the slope of the undisturbed area. The designer should evaluate and identify all potential areas for use of this control measure.

It is preferable that the vegetative strip is on the flatter area beyond the toe of slope. This does not preclude leaving as much vegetation on the slope as possible. If site conditions exist that do not allow for locating a filter strip on the flatter ground, the designer should make every effort to preserve vegetation on the slope. The vegetative filter strip may be considered for undisturbed areas within the construction limits.

Where vegetative filter strips are to be used independent of other measures, the strips should be in accordance with or exceed the requirements shown in Figure 37-3C.

Where existing vegetation cannot be in accordance with the minimum requirements shown in Figure 37-3C, there are still advantages to leaving the vegetation in place. However, the vegetative strip should be used in conjunction with other appropriate practices. If silt fence is to

be used in conjunction with a filter strip, the fence should be installed 3 m from the toe of the slope on the flatter ground.

37-3.01(03) Sediment Trap

The sediment trap is an area located in the ditch line that is used to temporarily pond runoff, which allows the sediment to be contained. It is the last measure used in a ditch to filter water before it enters another legal drainage body. If the ditch grade is 5% or steeper, or if the ditch is 1000 m or longer, the last two measures in the ditch should be sediment traps. Revetment riprap should be used in construction of sediment traps.

If used independent of other sediment control measures, the sediment trap should be designed for up to a maximum drainage area of 2 ha. Where right-of-way is limited, the sediment trap should be designed considering the space rather than the drainage area. In this situation, other sediment control measures should be specified in conjunction with the sediment trap. Ideally, the trap should be designed to store sediment for a minimum disturbed volume of 125 m^3/ha. In order to determine the volume of the trap; the watershed that is tributary to the sediment trap should be calculated.

Figures 37-3E, 37-3F, and 37-3G indicate the minimum spillway design for a sediment trap.

The sediment trap design depends on the following geometric characteristics of the proposed ditch.

1. Ditch grade
2. Ditch shape (flat bottom or V-ditch)
3. Side slopes (fore- and backslope)

Figure 37-3G indicates the minimum spacing for sediment traps, based on the flood pool length, so that the next measure would not encroach into the pool of the previous one. The procedure is as follows:

1. Select the largest sediment trap, by spillway height, that could physically fit in the proposed ditch cross section

2. Check the proposed ditch grade directly upstream of the approximate location of the sediment trap. The grade should be continuous.

3. From the table for the appropriate ditch, find the required sediment trap spacing. The provided spacing should be at least as long as that shown in Figure 37-3G.

37-3.01(04) Sediment Basin

A sediment basin is a water impoundment structure formed with an embankment or by excavating a basin. It is used to prevent offsite sedimentation by retaining sediment on the construction site. A sediment basin should be a primary consideration for new construction projects when there is adequate right-of-way. It should be used within interchanges, rest areas, weigh stations, or replacement wetlands. Where right of way is limited, the sediment basin should be designed considering available space rather than drainage area. In this situation, other control measures should be specified in conjunction with the sediment basin depending on site conditions.

Typically, the sediment basin is the last control measure encountered by runoff before it leaves the construction site. It is ordinarily about twice as long as it is wide, but it must be shaped to fit the area it will be used in. It should therefore be designed and detailed for each specific site, as no standard details have been developed. However, a typical schematic detail is shown in Figure 37-3H. If used independent of other sediment control measures, the basin should be designed for a drainage range of 2 to 12 ha. The basin should be designed to store a minimum water volume of 125 m^3/ha for the watershed. If the watershed area is greater than 12 ha additional consideration should be given.

A wetland replacement site or detention pond may be used temporarily as a sediment basin. For guidance in the use of wetlands replacement sites as sediment basins, contact the Division of Design's Hydraulics Engineer. If the permanent control structure of the wetland replacement site or detention pond is a pipe, a temporary perforated riser should be used to dewater the basin allowing for adequate residence time in the basin.

This sediment control measure should not be used where failure of the embankment would endanger life or property. Temporary right-of-way may be provided where possible.

37-3.02 Slopes

The following measures are used to temporarily control erosion on slopes. These measures include interceptor ditches and slope drains, vegetative strips in cut sections, temporary seeding and temporary mulching, erosion control blankets, and surface roughening.

37-3.02(01) Interceptor Ditch and Slope Drain

An interceptor ditch, in combination with temporary or permanent seeding, protects work areas from runoff and diverts water to sediment traps or protected flow areas. Interceptor ditches are

constructed to protect work areas, fill slopes, or cut slopes. They should be constructed and graded to drain to provide positive drainage. Slope drains are pipe drains used in conjunction with interceptor ditches to convey runoff down a slope without causing erosion. An interceptor ditch with a slope drain should be specified at the top of fill slopes to divert runoff from the top of the embankment and control where the runoff is discharged. Where cut or fill height exceeds 3 m, a slope drain should be used. The INDOT *Standard Drawings* specify the pipe diameter and its drainage area. This information is useful in determining the spacing of slope drains.

The contractor should be permitted to use a temporary pipe slope drain or an open slope drain. The slope drain should be lengthened as the embankment is extended upward. Slope drains should never be outlet directly into streams due to the possible conveyance of sediment from the top of the embankment. Instead, they should be outlet onto a riprap splash pad and into another sediment control measure.

37-3.02(02) Interceptor Ditch or Vegetative Strip in Cut Sections

An interceptor ditch in accordance with Section 37-3.02(01) may be warranted in a cut section at the right-of-way line to divert runoff from the construction site to adjacent properties. Another method for addressing this situation is to specify that a vegetative strip be left at the right-of-way line to filter runoff from the construction site. This measure would not be a pay item. However, the strip should be shown on the erosion and sediment control plan, to indicate that the contractor should not clear the area.

37-3.02(03) Temporary Seeding and Temporary Mulching

Temporary seeding and mulching are used to reduce erosion and sedimentation damage by stabilizing disturbed areas where additional work is not scheduled for at least 15 calendar days. Temporary seeding reduces problems associated with mud or dust from bare soil surfaces during construction and also reduces sediment runoff downstream by providing temporary stabilization. Mulching protects the soil from the impact of wind and water, prevents the soil from crusting, conserves moisture, and promotes seed germination and growth. Temporary seeding and mulching are often used in concert, although temporary mulching should be used when temporary seeding is not reasonable, such as during the winter months. The seasonal requirements for the use of temporary seeding and mulching are shown in the INDOT *Standard Specifications*. Temporary seeding and mulching should be included as pay items in the project quantities in accordance with the INDOT *Standard Specifications*.

The pay quantity for temporary seeding should be determined based on the contract type as follows:

1. Bridge Contract: Based on the same area as permanent seeding.

2. Road Contract: Based on one-half the area of permanent seeding.

3. Maintenance, Traffic, or Resurfacing Contract: No pay quantity need be included unless an analysis of the project shows it to be necessary.

A different pay quantity for temporary seeding may be shown if an analysis of the project shows it to be warranted.

When mulch is used during certain periods of the year instead of temporary seed, a pay quantity for mulch should also be included in bridge and road contracts. The quantity specified should be doubled, to cover the areas to be temporarily and permanently seeded. No additional quantity of mulch need be shown if a quantity is already included.

37-3.02(04) Erosion Control Blankets and Surface Roughening

If erosion control blankets are required as permanent measures, and the special provisions require their early installation, they may be used as a temporary erosion control measure. Surface roughening is required by the INDOT *Standard Specifications* for construction of erosion control methods. The designer need not consider the measure as part of the temporary erosion and sediment control plan.

37-3.03 Side Ditches

The measures used to control sediment in side ditches include check dams, sediment traps, and grass/riprap lined channels. Figure 37-3L shows the measures to be used with a disturbed ditch. Figure 37-3M shows the measures to be used with an undisturbed ditch.

37-3.03(01) Check Dams

Check dams are used to reduce erosion in a drainage channel by slowing the velocity of the flow. Check dams are commonly used in channels that are degrading but where permanent stabilization measures are impractical due to their short period of usefulness or in eroding channels where construction delays or weather conditions prevent timely installation of erosion resistant linings. Check dams should not be used in intermittent/perennial streams. Check dams should only be used in areas with drainage areas less than or equal to 0.8 ha. Revetment riprap check dams should be specified for use if they are outside the construction clear zone and are not exposed to public traffic. Straw bale check dams should be specified for use only if they are

inside the construction clear zone and are exposed to public traffic. See the INDOT *Standard Drawings* for details.

Check dams should be wide enough to traverse the ditch section to force water to flow over the check dam instead of around the ends.

Figures 37-3J and 37-3K provide guidance in developing quantities based on the spacing of revetment riprap check dams. The spacing dimensions listed below were determined based on a 1.2-m bottom ditch with 4:1 fore- and backslopes. For other ditch cross sections, the spacing should be recalculated. It is not necessary to specify the spacing on the plans. The check dams should be spaced such that the top of the downstream check is at the same elevation as the toe of the adjacent upstream check dam.

The mass of revetment riprap may be calculated by using Figure 37-3 I and the following formula.

$$\text{Mass (Mg)} = 1.8\,[(0.41)\,(b + c) + 0.81a]$$

Geotextile is required under the riprap and as an apron as shown on the INDOT *Standard Drawings.* The area to be covered with geotextile is as follows:

$$\text{Area } (m^2) = 3.7a + 1.94\,(b + c)$$

37-3.03(02) Sediment Traps in Side Ditches

Sediment traps are used in side ditches in lieu of, or in conjunction with, check dams. They allow sediment to settle out of the water instead of damming the sediments as with check dams. Riprap quantities are shown in Figures 37-3N, 37-3 O, and 37-3P. See Section 37-3.01(03) for details.

37-3.03(03) Grass/Riprap Lined Channels

Grass or riprap should be placed in channels early in the construction process. These measures may be used as temporary erosion and sediment control measures, then retained as permanent features.

37-3.04 Streams

Sediment basins and silt fences are used to control sediment at streams. Although all of the measures contribute to the reduction of sediment that could enter a stream, the measures below usually apply adjacent to the stream.

37-3.04(01) Sediment Basin Alongside Stream

A sediment basin is generally used as a last sediment control measure, in a line of several measures, before runoff is allowed to enter a waterway. This measure may not be necessary on projects with small disturbed areas. A sediment basin allows sediments to settle out of the water. See Section 37-3.01(04) for details concerning this measure.

37-3.04(02) Silt Fence Alongside Stream

Where a stream is adjacent to an exposed fill slope, the stream should be protected from sediment by use of a silt fence alongside the stream as described in Section 37-3.01(01).

37-3.05 Inlets

Prevention of sedimentation of streams includes protection of storm water inlets. The inlet protection measures described below have been established to handle maximum drainage areas of 0.4 ha. If the drainage area is greater than 0.4 ha per inlet, then additional measures should be used in conjunction with the inlet-specific protection measures.

37-3.05(01) Ditch Inlet Protection

Ditch inlet protection is used to keep sediment from entering an inlet. Ditch inlet protection is needed only where there is a likelihood that sediment will enter the inlet. The designer should include ditch inlet protection in the erosion and sediment control plan only where such plan calls for disturbing the area around the inlet. The contractor should be given the option of using silt fence, slotted barrel, or aggregate ring inlet protection. These measures all capture sediment at the approach to a storm drain inlet, allowing full use of the storm drain system during the construction period. See the INDOT *Standard Drawings* for details. Pay quantities for ditch inlet protection should be determined on a per-each basis.

37-3.05(02) Curb Inlet Protection

Curb inlet protection should be provided where a road is still closed to traffic, or is being used by the contractor as a haul road, and there is a reasonable potential for sediment to wash onto the road from surrounding areas or be tracked by construction equipment. There are no sediment control measures that the designer may take regarding this situation. Measures which the contractor must consider are described in the INDOT *Standard Specifications.*